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Impact-Induced Mission Effects and Risk Assessments (3)

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MEASURING IMPACT CRATERS ON THE ISS COLUMBUS MODULE

Abstract

A photographic survey of the outer surface of the Columbus module with emphasis on the forward facing areas is proposed. This is to perform a status check of the Columbus meteoroid and debris protection system (MDPS) and to obtain information on the space debris and meteoroid environment of the ISS. The majority of impacts is expected on the front/forward side of the cylindrical area.

Two possibilities to perform the survey are investigated: by a camera on the robotic arm SSRMS with the possible utilization of Dextre/SPDM, as well as by an astronaut during an EVA with the standard Nikon D4 camera. Both methods are discussed in detail, including planning effort, execution requirements and constraints, the results and effort expected, and advantages and disadvantages of both methods are summarized.

The predicted crater size distribution is calculated using ESA's MASTER model, and the proposed survey is compared with historical mission data that were used to validate the MASTER population in the past. The different directionality of man-made space debris and natural meteoroids particle populations leads to a relative difference in expected impact crater distributions between the front facing and the zenith facing areas, which can be analyzed.

The main aim of the survey is to generate measurement data for particle environment models (MASTER and ORDEM). This data would allow for a quantitative assessment of the particle impact risk for the entire ISS with an unprecedented accuracy. Also, it would allow to re-assess the assumptions that were made during the Columbus module shield design process and thus would allow re-evaluating the actual impact risk.

Since the Columbus module surface will be covered partially by the commercial platform "Bartolomeo" soon, there is a limited time slot for the actual performance of this study. Having this in mind, the data generated by this survey can also help secure the economic investment that is planned for Bartolomeo in two ways: The improved particle models will help to understand what Bartolomeo is going to expect out there, and the new pictures of the Columbus surface may help to plan the installation process.